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Title: *Catastrophe Model of Substorm Onset*

Cluster: *Cross-Theme Theory and Data Analysis/SECTP*

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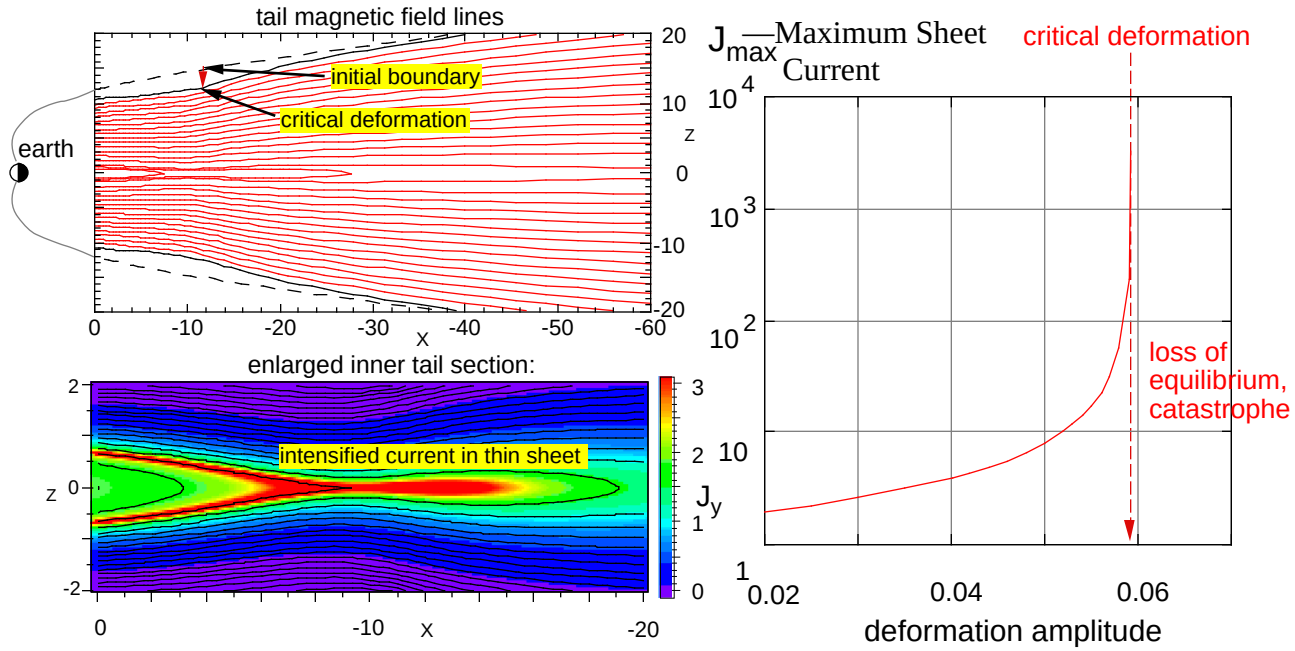
• Evidence Supports Catastrophe Model of Terrestrial Magnetic Substorm Onset

Theory and recent numerical simulations have demonstrated that only modest perturbations of the Earth's magnetotail boundary can cause the formation of a thin current sheet. When the perturbation exceeds a critical value the current sheet becomes catastophically unstable. Possible causes for the critical deformation of the tail boundary is the northward turning of an initially southward directed interplanetary magnetic field or the impact of a solar wind pressure pulse. This was recently demonstrated numerically in a model developed by a multi-institutional group (from Los Almos National Laboratory, Goddard Space Flight Center and the University of Maryland) that is supported by the NASA Sun-Earth Connections Theory Program. This result provides further evidence supporting the theory of a catastrophic source for the magnetic substorm onset. Its important consequences could include the onset of reconnection, the collapse of the magnetotail and the formation of plasmoids.

Understanding how the Earth's magnetosphere responds to changes in the solar wind is an important component of the Sun-Earth Connections Roadmap quest to understand how the Earth and Planets respond to solar variations. This new result is a significant achievement in furthering our capability to predict Space Weather effects in the near-Earth environment, and it provides a detailed cause and effect scenario that can be used for planning spacecraft studies of substorm mechanisms.

Small Boundary Deformation Leads to Current Sheet Intensification and Breakup



Reference: Birn, J., and K. Schindler, "Thin current sheets in the magnetotail and the loss of equilibrium", *J. Geophys. Res.*, in press, 2002.